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ABSTRACT

Reported are the results of a national survey conducted by the American Association of School Administrators to determine energy consumption in the nation's schools for the 1977-78 school year. Usable responses were received from 30% of the sample. Data indicate that, while energy consumption over a five-year period had been reduced, there is ample room for further conservation efforts. (PB)

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AASA ENERGY USE STUDY

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American Association of School Administrators

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AASA ENERGY USE STUDY

The American Association of School Administrator's 1979 survey of energy consumption in the nation's schools revealed a 35% drop in energy use since 1973. The survey revealed that the current median is 104,445 BTU's/sq. ft. compared to the median 161,312 BTU's/sq. ft. findings by the Federal Energy Administration at the time of the embargo. The study also showed that school districts with enrollment over 5,000 consumed 11.6% less fuel than districts below 5,000 enrollment.

The survey also provided data previously unavailable on the types of fuel used in the schools. Earlier estimates suggested 30 - 40% of the schools used natural gas. This is considerably below the 55% reported in the study. For the first time, it is known that the majority of schools in America burn natural gas. The data also revealed that school consumption by fuel type varies markedly by regions of the country. For example, in Federal Energy Region 5 consumption of oil (all grades) was 31% while Federal Energy Region 6 had only .3%.

Sample

A systematic random sample was drawn from the American Association of School Administrators (AASA) membership list stratified by district size. The ratio 1:4 for districts over 25,000 enrollment was used and 1:7 for districts under that figure. A total sample of 2127 was drawn. The sample was matched to the universe of school systems (CIC list) and found to be generally representative of district sizes. (See Appendix A.) The sample was also matched to the number of districts in the ten federal energy regions. (See Appendix B.)

Methodology

The survey instrument was developed in consultation with the Department of Energy and with the Educational Research Service that compiled and analyzed the data.

The instrument was mailed in January, 1979 and a second mailing was sent out in March, 1979. The response rate exceeded 50% at the April 13, 1979 deadline. Because of the complexity of the data requested, all responses were cleared by hand and many verifying phone calls were made. Of the responses received, 629 were deemed usable. The usable response rate was thus 29.57%. While this was statistically sufficient to satisfy the conditions of the study, it is noted that responses by specific cells, i.e., certain fuel types in certain regions are so low that caution is warranted in interpreting the findings. In certain instances the n was too low to treat the data at all. Where this is a concern, n is provided in the tables to assist the reader in assessing the data.

An analysis of the usable responses indicated that Region 5 (IL, IN, MI, MN, OH, and WI) was overrepresented and districts under 300 in size were underrepresented. (Also shown in Appendix A.)

Treatment of the data

The data was not adusted for climate, but it is noted that the degree days for the study's time frame, school year 1977-78 or calendar year 1978, was significantly higher than for the 1973-74, the year upon which comparisons are based.

In other words, the reductions in consumption noted were made in a year when climatic demands on energy were much greater. Indeed, the weather bureau indicates it was one of two of the worst years in the last 50. The effects of school closings in the winter of 1977-78 due to fuel curtailment was also considered; but since the total number of pupil days lost was less than 1% of the operational demand, it was disregarded in the findings presented.

While the number and percentage of electrically cooled schools are given, the schools are not counted in the total figures as most of these buildings are also heated and thus would be counted twice.

FINDINGS

Table 1 indicated the median BTU's/sq. ft. by total and by Federal Energy Administration's (FEA) earlier findings. It should be noted that while AASA's sample was randomly drawn, FEA's was a fortuitous, or problematic sample, thus limiting the opportunity to make inferences. Nevertheless, the FEA national survey provides the only other available data on school energy consumption.

Consumption figures by region logically follow the respective severity of the climate. Figure 1 indicates the states comprising each federal energy region. However, the difference in energy reduction by region cannot be explained by known factors; i.e., cost of fuel, type and availability of fuel, or energy conservation programs at the state or regional level.

The study did not encompass the manner in which the reductions were achieved nor the amount of money invested in energy conserving measures. Knowledge of school energy operations outside the study suggests savings can be primarily attributed to changes in operations, more energy conscious maintenance, and implementation of low cost retrofits.

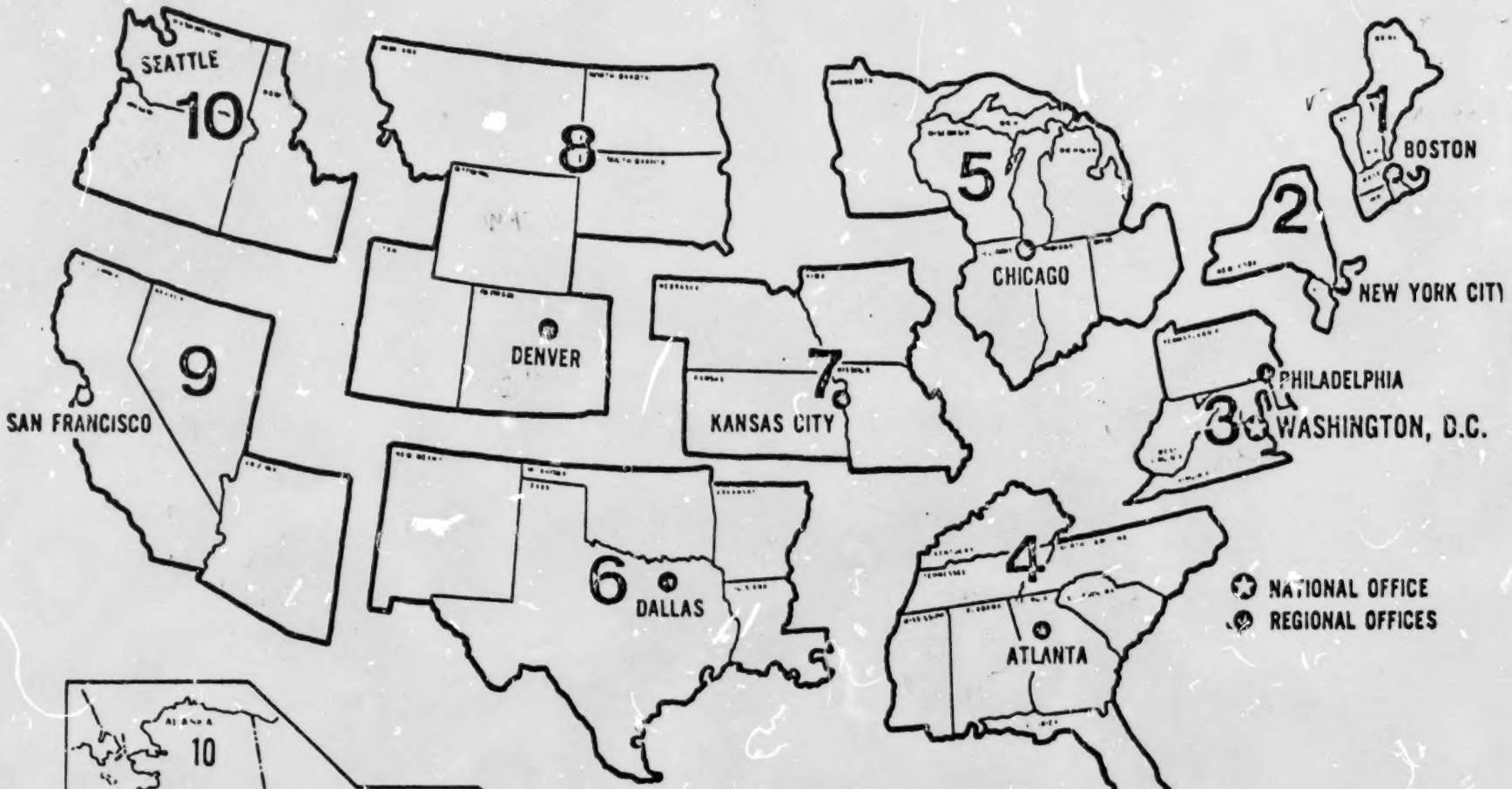
Table 1. Median Consumption All Fuels (in BTU's/sq. ft.)

	1972-73*	1977-78	% Changes 1972-1973 to 1977-78
TOTAL	161,312	104,445	35.25
Federal Energy Region			
1	176,710	114,999	34.92
2	185,999	109,687	41.03
3	166,069	111,241	33.01
4	112,013	75,604	32.50
5	184,948	110,488	40.26
6	132,603	77,907	41.25
7	163,245	117,766	27.86
8	182,640	120,103	34.24
9	131,342	66,523	49.35
10	162,761	85,978	47.17

*Federal Energy Administration's School Fuel Impact Survey

FIGURE 1

FEDERAL ENERGY OFFICE - REGIONS



PUERTO RICO, VIRGIN ISLANDS	REGION 2
CANAL ZONE	REGION 4
AMERICA SAMOA, GUAM TRUST TERRITORY OF THE PACIFIC ISLANDS	REGION 9

Further consideration of the median BTU's/sq. ft. suggests consumption is also a function of district size. Table 2 shows that districts over 5,000 consume 11.6% less than those under 5,000 which suggests the benefits of on-staff expertise. The matter warrants closer scrutiny. If these findings are corroborated, the use of educational service agency resources to assist smaller districts could present a very cost-effective vehicle for training and technical assistance.

Fuel types

One of the interesting facets of the findings was an analysis of types of fuel used by the schools, nationally and by regions of the country. No figures were available prior to the AASA study. Natural gas consumption on a national basis came in surprisingly higher than anticipated at 55%. Table 3 depicts the fuel source for the reporting buildings and the percentage they represent on a national basis.

The variations in fuel source by region was far greater than expected. Table 4 shows fuel sources by region. This table reveals differences of considerable importance to decisions relative to energy in the schools. For example, the difference between Region 3's 31% and Region 6's .3% in oil consumption is significant to those wishing to reduce oil imports. Any analysis of the economic impact of gas deregulation on the schools should consider that the impact will be much greater in Regions 4, 5, 6, and 9 and relatively little effect would be seen in Regions 1, 2 and 10. Coal strikes would hit Regions 3, 4, and 5 hardest.

Table 5 provides an analysis of fuel sources region by region. In Region 1, for example, oil supplies 79% of the schools energy needs while 11% is gas and 9% electricity. Conversely, Region 6 relies on natural gas to serve 79% of its school needs while oil is negligible and electricity contributes 18%.

Table 2. Median Btu's/sq. ft. by District Enrollment

	District Enrollment	
	Less than 4999	5000 or more
n	488	123
Median Btu/sq. ft.	107,294	94,826

Table 3. Fuel Sources; All Buildings

Fuel Type	No. of Bldgs. Reported and Percentage N	%
Natural Gas	5999	54.89
Oil (all grades)	2734	25.01
Electricity Htg/cooling	809	7.40
Htg only	962	8.80
Cooling only	(852)	
Propane	220	2.01
Coal	168	1.54
Butane	19	.002
Diesel	16	.0015
Total Value	10929	99.65

Table 4. Percentage Consumption by Region of Specified Fuels
(By school building count)

FUEL SOURCE

Fed. En. Region		Natural Gas	Oil	Electrical Htg/c	Electrical Htg/only	Electrical Co/only	Coal	Propane
1	n	34	236	13	16	9	-	4
	%	.6	8.6	2	2	1	0	2
2		81	293	9	37	13	-	1
		1	10.7	1	4	1	0	.4
3		255	854	97	58	125	53	1
		4	31	12	6	15	31	.4
4		1072	248	182	220	205	36	99
		18	9	22	23	24	21	45
5		1215	447	106	149	101	53	9
		20	16	13	15	12	31	4
6		1370	9	206	104	168	-	25
		23	.3	25	11	20	0	11
7		456	164	51	45	33	6	42
		8	6	6	5	4	3	19
8		348	54	44	204	14	11	22
		6	2	5	21	2	6	10
9		1044	45	54	73	165	-	13
		17	1.6	7	7	19	0	6
10		124	387	47	56	19	9	4
		2	14	6	6	2	5	2
Total		5999	2734	809	962	852	168	220

Table 5. Percentage of Fuel Sources, Federal Energy Region;
(n < 10 not treated, shown by X)

Federal Energy Regions

	1	2	3	4	5	6	7	8	9	10
Fuel Type n	34	81	255	1072	1215	1370	456	348	1044	124
Natural Gas n = 5999 %	11	19	19	58	61	79	60	51	84	19
Oil (all grades) n = 2734	236	290	854	248	447	9	164	54	45	387
	79	69	65	13	23	X	21	8	4	61
Electricity htg/cooling n = 809	13	9	97	182	106	206	51	44	54	47
	4	X	7	10	5	1	7	6	4	7
htg. only n = 962	16	37	58	220	149	104	45	204	73	56
	5	9	4	12	7	6	6	30	6	9
cooled only n = 852	*									
Propane n = 220	4	1	1	99	9	25	42	22	13	4
	X	X	X	5	X	1	5	3	1	X
Coal n = 168	-	-	53	36	53	-	6	11	-	9
	X	X	4	2	3	X	X	1.6	X	X
Butane n = 19	-	-	-	-	-	16	-	-	3	-
	X	X	X	X	X	.9	X	X	X	X
Diesel n = 16	-	-	-	-	-	-	-	-	5	11
	X	X	X	X	X	X	X	X	X	2
All Fuels Total n = 10929										

* No total figures are given for electrically cooled buildings because most of these buildings are also heated and thus would be counted twice.

The data also revealed that district size appears to influence some fuel usage. The larger districts use a disproportionate amount of natural gas while small districts show greater reliance on electricity. Oil, on the other hand, seems to supply about 25% of the districts, regardless of size. Table 6 presents the percentages of certain fuels used relative to district size.

CONCLUSIONS AND RECOMMENDATION

This survey, conducted at AASA's expense, for the first time provides some very important and usable data on patterns of school energy use. It affords decision-makers with valuable information. AASA expects to conduct similar surveys in the future.

While 35% reduction in consumption over a five year period is quite remarkable, the average 1977-78 consumption figure of 104,445 BTU's/sq. ft. still leaves room for further conservation efforts. Reductions to date can most likely be attributed to operations and maintenance changes as well as low cost retrofits. A study of how the reductions were achieved would be of value.

Reductions suggest schools are clearly ready to take advantage of federal assistance in the school energy grants program. The fine savings already evident suggest that the self-helps are rapidly being exhausted and assistance with capital investments to save energy can now bring maximum benefits.

Difference in consumption in various fuels by region warrants careful scrutiny. In certain regions where fuel consumption profiles are distinctive, technical assistance and specific conservation efforts should be adapted accordingly

Table 6. Fuel Source by District Size;
Number of Blogs & Percentages

	Less than 600 n = 419		600 to 4999 n = 2996		5000 or more n = 7353	
Fuel Type	n	%	n	%	n	%
Natural Gas n = 5999	154	37	1446	48	4327	59
Oil (all grades) n = 2734	103	25	732	24	1853	25
Electricity Htg/cooling n = 809	20	5	254	8	528	7
htg only n = 962	72	17	341	11	524	7
(cooling only) n = 852	(19)		(153)		(671)	
Propane n = 220	47	11	138	5	28	.4
Coal n = 168	11	3	78	3	77	1
Butane n = 19	9	2	-		10	.1
Diesel n = 16	3	.7	7	.2	6	.08

While the magnitude of consumption differences by district size should be studied further, those differences are sufficient to recommend that more attention be paid to assisting smaller districts in their efforts to conserve energy. Educational service agencies, referred to as "coordinating agencies" in the school energy grants program, are natural vehicles for offering this critical assistance. Methods of utilizing the services of these intermediate units should be explored.

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Universe*/Sample/Respondent Breakdowns by Enrollment Groups

Enrollment Group	CIC Universe		Sample			Respondents	
			Sampling Ratio	#	%	#	%
25,000 or more	413	2.8%	1:4	103	4.8%	33	5.2%
10,000 to 24,999	633	4.3	1:7	90	4.2	32	5.1
5,000 to 9,999	1220	8.4	1:7	174	8.2	58	9.2
3,000 to 4,999	1491	10.2	1:7	213	10.0	65	10.3
1,000 - 2,999	4099	28.1	1:7	586	27.6	191	30.4
600 - 999	1796	12.3	1:7	257	12.1	98	15.6
300 - 599	2139	14.7	1:7	306	14.4	75	11.9
299 or less	2784	19.1	1:7	398	18.7	59	9.4
Total	14,575	100.0		2127	100.0	629**	97.1***

*Curriculum Information Center 1978-79 tape of all U.S. public school districts (enrollment based on fall, 1977 figures).

**Response rate was therefore 29.6 percent.

***No enrollment data provided by 2.9 percent of responderts.

APPENDIX A

Number/Percent of Local Public School Districts (Fall, 1977) in the U.S. by DOE Energy Region*

Enrollment Range	U.S. Total	Department of Energy: Energy Regions 1	2	3	4	5	6	7	8	9	10
25,000 or more	187	3	8	20	47	26	29	8	7	34	5
10,000 to 24,999	530	37	49	61	78	91	59	19	22	92	22
5,000 to 9,999	1104	87	135	133	210	221	152	46	18	114	47
2,500 to 4,999	2067	165	254	257	343	548	171	74	59	134	71
1,000 to 2,999	3463	253	405	248	331	1130	368	290	99	206	133
600 to 999	1864	121	169	18	52	538	312	320	97	140	97
300 to 599	2323	157	161	7	33	465	507	473	236	158	126
Fewer than 300	4296	367	141	1	5	373	709	1189	822	393	296
Total in Region	15884	11900	1322	745	1090	3392	2248	2419	1351	1271	797
Percent of total U.S.	100.0	7.5	8.3	4.7	6.9	21.4	14.1	15.3	8.5	8.0	5.0
Respondents %		5.1	9.2	7.5	6.0	31.3	11.1	11.4	5.9	5.9	6.5

*Source of data: Table 4 (Number of operating local public school systems, by size of school system and state: United States, fall 1977), p. xix, Education Directory Public School Systems 1977-78, by Jeffrey W. Williams and Sallie L. Warf, National Center for Educational Statistics, 1978.

APPENDIX B